

## Appendix A: List of Acronyms

AASHTO	American Association of State Highway and Transportation Officials
AD	Archived Data
ADUS	Archived Data User Service
ANSI	American National Standards Institute
APTS	Advanced Public Transportation Systems
ASTM	American Society For Testing and Materials
ATIS	Advanced Traveler Information Systems
ATMIS	Advanced Transportation Management and Information Systems
ATMS	Advanced Transportation Management Systems
AVI	Automated Vehicle Identification
AVL	Automated Vehicle Locator
AVSS	Advanced Vehicle Safety Systems
CAD	Computer Aided Dispatch
Caltrans	California Department of Transportation
CCTV	Closed Circuit Television
CEA	Consumer Electronics Association
CTC	County Transportation Commission
CVISN	Commercial Vehicle Information Systems & Networks
CVO	Commercial Vehicle Operations
CHP	California Highway Patrol
CMS	Changeable Message Sign
DOT	Department of Transportation
EM	Emergency Management
FHWA	Federal Highway Administration
FSP	Freeway Service Patrol
FTA	Federal Transit Administration
HAR	Highway Advisory Radio
HOV	High Occupancy Vehicles
IEEE	Institute of Electrical and Electronics Engineers
ISP	Information Service Provider
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation System(s)
MCO	Maintenance & Construction Operations
MOU	Memorandum of Understanding
MPO	Metropolitan Planning Organization
NEMA	National Electrical Manufacturers Association
PeMS	Freeway Performance Measurement System
RTP	Regional Transportation Plan
RTIP	Regional Transportation Improvement Program
RWIS	Road Weather Information Systems
SAE	Society of Automotive Engineers
STIP	State Transportation Improvement Program
TEA-21	Transportation Equity Act for the 21 <sup>st</sup> Century
TIP	Transportation Improvement Program
TMC	Transportation Management Center
TOC	Transportation Operations Center

## Appendix B: List of Stakeholders

Alameda County
Alameda County Transportation Commission (ACTA)
Alameda County Congestion Management Agency (ACCMA)
Alameda County Public Works Agency
Albany
Berkeley
Dublin
Emeryville
Fremont
Hayward
Livermore
Newark
Oakland
Piedmont
Pleasanton
San Leandro
Union City
Contra Costa County
Contra Costa Transportation Authority (CCTA)/Congestion Management Agency (CMA)
Contra Costa County Public Works - Transportation Engineering Division
TransPak / Contra Costa Commute Alternative Network (CCCAN)
Antioch
Brentwood
Clayton
Concord
Danville
El Cerrito
Hercules
Lafayette
Martinez
Moraga
Oakley
Orinda
Pinole
Pittsburg
Pleasant Hill
Richmond
San Pablo
San Ramon
Walnut Creek
Marin County
Marin County Congestion Management Agency
County of Marin, Department of Public Works, Traffic Engineering
Belvedere
Corte Madera
Fairfax
Larkspur
Mill Valley
Novato
Ross
San Rafael
Sausalito
Tiburon

Napa County	
	County of Napa, Public Works
	Napa County Transportation Planning Agency (NCTPA)/Congestion Management Agency (CMA)
	American Canyon
	Calistoga
	Napa
	St. Helena
	Yountville
San Francisco County	
	San Francisco County Transportation Authority/Congestion Management Agency (CMA)
	San Francisco Municipal Transportation Agency
	SF Departments of Parking and Traffic, of Telecomm and Info Services, and of Emergency Communica
San Mateo County	
	San Mateo County Transportation Authority
	San Mateo County Congestion Management Agency (City/County Association of Governments (C/CA
	County of San Mateo, Public Works, Engineering Services Division
	Atherton
	Belmont
	Brisbane
	Burlingame
	Colma
	Daly City
	East Palo Alto
	Foster City
	Half Moon Bay
	Hillsborough
	Menlo Park
	Millbrae
	Pacifica
	Portola Valley
	Redwood City
	San Bruno
	San Carlos
	San Mateo
	South San Francisco
	Woodside
Santa Clara County	
	Santa Clara Valley Transportation Authority/Congestion Management Program (CMP)+B175
	County of Santa Clara Roads and Airports Department
	Campbell
	Cupertino
	Gilroy
	Los Altos
	Los Altos Hills
	Los Gatos
	Milpitas
	Monte Sereno
	Morgan Hill
	Mountain View
	Palo Alto
	San Jose
	Santa Clara
	Saratoga
	Sunnyvale

Solano County	
	Solano Transportation Authority (STA)/Congestion Management Agency (CMA)
	Solano Link Consortium
	Solano County Transportation Department
	Benicia
	Dixon
	Fairfield
	Rio Vista
	Suisun City
	Vacaville
	Vallejo
Sonoma County	
	Sonoma County Transportation Authority (SCTA)/Congestion Management Agency (CMA)
	County of Sonoma, Transportation and Public Works
	Cloverdale
	Cotati
	Healdsburg
	Petaluma
	Rohnert Park
	Santa Rosa
	Sebastopol
	Sonoma
	Windsor
Regional Agencies	
	Association of Bay Area Governments (ABAG)
	Bay Area Air Quality Management District (BAAQMD)
	Bay Conservation and Development Commission (BCDC)
	California Department of Transportation (Caltrans) District 4
	Capitol Corridor Joint Powers Authority (CCJPA)
	Metropolitan Transportation Commission (MTC)
	Peninsula Congestion Relief Alliance
	Peninsula Corridor Joint Powers Board
Federal Agencies	
	Federal Emergency Management Agency (FEMA)
	Federal Highway Administration (FHWA)
	Federal Railroad Administration (FRA)
	Federal Transit Administration (FTA)
	US Coast Guard
State Agencies	
	California Air Resources Board
	California Alliance for Advanced Transportation Systems (CAATS)
	California Department of Transportation (Caltrans)
	California Transportation Commission
Emergency Services	
	California Highway Patrol (CHP), Golden Gate Division
	Local Fire Agencies
	Local Police Agencies
Air/Water Ports	
	Oakland International Airport (OAK)
	Port of Oakland
	Port of San Francisco
	San Francisco International Airport (SFO)
	San Jose International Airport (SJC)

	Toll Authority
	Golden Gate Bridge, Highway & Transportation District
	Caltrans Toll Operations
	Transit Agencies
	AC Transit
	Air-BART
	Alameda/Oakland Ferry
	Altamont Commuter Express
	American Canyon Transit
	Amtrak / Amtrak California
	Angel Island - Tiburon Ferry
	Bay Area Rapid Transit (BART)
	Benicia Transit
	Blue and Gold Fleet
	Brentwood Dimes-A-Ride
	Broadway Shuttle
	Burlingame Free Bee Shuttle
	Calistoga Handy Van
	Caltrain
	Capitol Corridor Rail Service
	Cloverdale Transit
	County Connection
	Dixon Redit-Ride
	Dumbarton Express
	Emery Go-Round
	Fairfield/Suisun Transit
	Foster City Sunshine Shuttle
	Golden Gate Ferry
	Golden Gate Transit
	Harbor Bay Ferry
	Healdsburg In-City Transit
	Intercity Van Go
	Menlo Park Midday Shuttle
	Napa Valley Transit
	Palo Alto Shuttle
	Petaluma Transit
	Rio Vista Transit
	San Francisco Municipal Railway (MUNI)
	San Mateo County Transit District (SamTrans)
	Santa Clara Valley Transportation Authority (VTA)
	Santa Rosa CityBus
	Sonoma County Transit
	Stanford Marguerite Shuttle
	Tri Delta Transit
	UC Berkeley Campus Shuttle
	Union City Transit
	Vacaville City Coach
	Vallejo Transit
	Valley Intracity Neighborhood Express (VINE)
	WestCAT
	WHEELS (LAVTA)
	WestCAT
	Yountville Shuttle

**Appendix C: Bay Area ITS Inventory (sorted by stakeholder agency)**

## Bay Area Architecture Inventory by Stakeholder

<i>Stakeholder</i>	<i>Element</i>	<i>Status</i>	<i>Architecture Entity</i>
<i>AC Transit</i>	AC Transit Next Bus Arrival System	Existing	Remote Traveler Support (Subsystem)
	AC Transit Operations System	Existing	Transit Management (Subsystem)
	AC Transit Vehicles	Existing	Transit Vehicle Subsystem (Subsystem)
<i>Alameda County Congestion Management Agency</i>	East Bay SMART Corridor Info Service Provider	Existing	Information Service Provider (Subsystem)
	East Bay SMART Corridor Roadside Equipment	Existing	Roadway Subsystem (Subsystem)
	East Bay SMART Corridor ATMS	Existing	Traffic Management (Subsystem)
<i>Bay Area Rapid Transit District</i>	BART Message Station System	Existing	Archived Data Administrator (Terminator)
	BART Transit/Rail Operations System	Existing	Remote Traveler Support (Subsystem)
	BART Vehicles	Existing	Transit Management (Subsystem)
	BART Website (Public)	Existing	Transit Vehicle Subsystem (Subsystem)
	BART Transit/Rail Operations System	Existing	Other ISP (Terminator)
<i>California Department of Motor Vehicles (DMV)</i>	CVO Administration (Pre-Pass)	Existing	Rail Operations (Terminator)
			Commercial Vehicle Administration (Subsystem)
<i>California Highway Patrol</i>	CHP Computer Aided Dispatch	Existing	Emergency Management (Subsystem)
	CHP Vehicles	Existing	Emergency Vehicle Subsystem (Subsystem)
	911 Call Center (cellular) Dispatch	Existing	Emergency Telecommunications System (Terminator)
<i>Caltrain</i>	Caltrain Rail Center Next Train Displays	Existing	Remote Traveler Support (Subsystem)
	Caltrain Rail Operations System	Existing	Transit Management (Subsystem)
	Caltrain Vehicles	Existing	Transit Vehicle Subsystem (Subsystem)
	Caltrain Rail Operations System	Existing	Rail Operations (Terminator)
<i>Caltrans District 4 (Electronic Tolling)</i>	Caltrans FasTrak System	Existing	Toll Administration (Subsystem)
	Caltrans FasTrak Toll Equipment	Existing	Toll Collection (Subsystem)

<i>Caltrans District 4 (Traffic Operations)</i>	Caltrans D-4 Transportation Management System	Existing	Information Service Provider (Subsystem)
	Bay Area Incident Response System (BAIRS)	Planned	Maint. and Construction Management (Subsystem)
	Caltrans D-4 Maintenance Vehicles	Existing	Maintenance and Construction Vehicle (Subsystem)
	Caltrans D-4 TMC Roadside Equipment (TOS)	Existing	Roadway Subsystem (Subsystem)
	Caltrans D-4 Transportation Management System	Existing	Traffic Management (Subsystem)
		Existing	Archived Data Administrator (Terminator)
<i>Caltrans Headquarters</i>			
	CVO Weigh Stations (Pre-Pass)	Existing	Commercial Vehicle Check (Subsystem)
<i>City of Antioch</i>			
	SR 4 East SMART Corridor Roadside Equipment	Planned	Roadway Subsystem (Subsystem)
	SR 4 East SMART Corridor ATMS	Planned	Traffic Management (Subsystem)
<i>City of Concord</i>			
	Concord - Walnut Creek - Pleasant Hill SMART Corridor Roadside Equipment	Existing	Roadway Subsystem (Subsystem)
	Concord - Walnut Creek - Pleasant Hill SMART Corridor ATMS	Planned	Traffic Management (Subsystem)
<i>City of Fairfield</i>			
	Suisun - Fairfield - Vacaville SMART Corridor Roadside Equipment	Existing	Roadway Subsystem (Subsystem)
	Suisun - Fairfield - Vacaville SMART Corridor ATMS	Planned	Traffic Management (Subsystem)
<i>City of Oakland</i>			
	Oakland Transportation Management System	Planned	Information Service Provider (Subsystem)
	Oakland TMC Roadside Equipment	Existing	Roadway Subsystem (Subsystem)
	Oakland Transportation Management System	Planned	Traffic Management (Subsystem)
<i>City of Pleasanton</i>			
	I-580 SMART Corridor ATMS Roadside Equipment	Existing	Roadway Subsystem (Subsystem)
	I-580 SMART Corridor ATMS	Existing	Traffic Management (Subsystem)
<i>City of San Jose</i>			
	San Jose Transportation Management System	Existing	Information Service Provider (Subsystem)
	San Jose TMC Roadside Equipment	Existing	Roadway Subsystem (Subsystem)
	Silicon Valley SMART Corridor Roadside Equipment	Existing	Roadway Subsystem (Subsystem)
	San Jose Transportation Management System	Existing	Traffic Management (Subsystem)
	Silicon Valley SMART Corridor ATMS	Existing	Traffic Management (Subsystem)



*City/County of San Francisco*

Combined City/County Emergency Services Center	Existing	Emergency Management (Subsystem)
Combined City/County Emergency Vehicles	Existing	Emergency Vehicle Subsystem (Subsystem)
SFgo Transportation Management System	Existing	Information Service Provider (Subsystem)
MUNI Kiosks	Planned	Remote Traveler Support (Subsystem)
SFgo Roadside Equipment	Existing	Roadway Subsystem (Subsystem)
SFgo Transportation Management System	Existing	Traffic Management (Subsystem)
MUNI Transit Operations System	Existing	Transit Management (Subsystem)
MUNI Vehicles	Existing	Transit Vehicle Subsystem (Subsystem)

*Financial Institutions*

Financial Institutions	Existing	Financial Institution (Terminator)
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*Golden Gate Bridge Highway and Transportation District*

GGBHTD Toll Authority/FasTrak System	Existing	Toll Administration (Subsystem)
GGBHTD Toll Collection/FasTrak Field Equipment	Existing	Toll Collection (Subsystem)
Golden Gate Transit Operations System	Existing	Transit Management (Subsystem)
Golden Gate Transit Vehicles	Existing	Transit Vehicle Subsystem (Subsystem)

*Media*

Media	Existing	Information Service Provider (Subsystem)
	Existing	Media (Terminator)

*Metropolitan Transportation Commission*

TravInfo and Regional Archive System	Existing	Archived Data Management Subsystem (Subsystem)
Freeway Service Patrol (FSP)	Existing	Emergency Management (Subsystem)
FSP Tow Trucks	Existing	Emergency Vehicle Subsystem (Subsystem)
511 System	Existing	Information Service Provider (Subsystem)
TravInfo and Regional Archive System	Existing	Information Service Provider (Subsystem)
511 Webpage and Personal Info Access System	Existing	Information Service Provider (Subsystem)
	Existing	Personal Information Access (Subsystem)
TransLink Field Equipment (Kiosks)	Existing	Remote Traveler Support (Subsystem)
TravInfo Roadside Equipment	Existing	Roadway Subsystem (Subsystem)
Bay Area Toll Authority Administration/FasTrak System	Existing	Toll Administration (Subsystem)
TravInfo and Regional Archive System	Existing	Traffic Management (Subsystem)
Regional Transit Information System (RTIS)	Existing	Transit Management (Subsystem)
TransLink System	Existing	Transit Management (Subsystem)
Bay Area Call Box Call Answering Center (CAC)	Existing	Emergency Telecommunications System (Terminator)
511 System	Existing	Other Archives (Terminator)

*Partners for Advanced Transit and Highways*

Performance Monitoring System (PeMS)	Existing	Archived Data Management Subsystem (Subsystem)
	Existing	Other TM (Terminator)

*Private Truck Drivers*

Commercial Vehicles	Existing	Commercial Vehicle Subsystem (Subsystem)
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<i>San Mateo County Transit District</i>		
SamTrans Transit Operations System	Existing	Transit Management (Subsystem)
SamTrans Vehicles (Buses and Paratransit)	Existing	Transit Vehicle Subsystem (Subsystem)
<i>Santa Clara Valley Transportation Authority</i>		
VTA Transit Operations System	Existing	Transit Management (Subsystem)
VTA Vehicles	Existing	Transit Vehicle Subsystem (Subsystem)
<i>Sub-Regional and Local Cities/Counties</i>		
Sub-regional and Local City/County Fire Department Systems	Planned	Emergency Management (Subsystem)
Sub-regional and Local City/County Police/Sheriff Department Systems	Planned	Emergency Management (Subsystem)
Sub-regional and Local City/County Police/Sheriff Vehicles	Planned	Emergency Vehicle Subsystem (Subsystem)
Sub-regional and Local City/County Fire Dept Emergency Vehicles	Planned	Emergency Vehicle Subsystem (Subsystem)
Sub-regional and Local City/County Roadside Equipment	Existing	Roadway Subsystem (Subsystem)
Sub-regional and Local City/County Traffic Operations Systems	Existing	Traffic Management (Subsystem)
Sub-regional and Local City/County Transit Operations Systems	Planned	Transit Management (Subsystem)
Sub-regional and Local City/County Transit Vehicles	Existing	Transit Vehicle Subsystem (Subsystem)
911 Call Center (land line) Dispatch	Existing	Emergency Telecommunications System (Terminator)
<i>Transit Agencies</i>		
Kiosks (transit)	Existing	Personal Information Access (Subsystem)
<i>Traveling Public (Commuters) @ Large</i>		
User Personal Computing Devices	Existing	Personal Information Access (Subsystem)
Personal Vehicles with toll tags (FasTrak)	Existing	Vehicle (Subsystem)
<i>Various Rail Owners - Operators</i>		
Commuter Rail Operations System	Existing	Transit Management (Subsystem)
Commuter Rail Operations Transit Vehicle	Existing	Transit Vehicle Subsystem (Subsystem)
Commuter Rail Operations System	Existing	Rail Operations (Terminator)

**Appendix D: Bay Area ITS Inventory (sorted by architecture entity)**

## Bay Area Inventory by Architecture Entity

Architecture Entity	Element	Stakeholder
Archived Data Management Subsystem	Performance Monitoring System (PeMS) TravInfo and Regional Archive System Commercial Vehicle Administration CVO Administration (Pre-Pass)	Partners for Advanced Transit and Highways Metropolitan Transportation Commission  California Department of Motor Vehicles (DMV)
Commercial Vehicle Check	CVO Weigh Stations (Pre-Pass)	Caltrans Headquarters
Commercial Vehicle Subsystem	Commercial Vehicles	Private Truck Drivers
Emergency Management	CHP Computer Aided Dispatch Combined City/County Emergency Services Center Freeway Service Patrol (FSP) Sub-regional and Local City/County Fire Department Systems Sub-regional and Local City/County Police/Sheriff Department Systems	California Highway Patrol City/County of San Francisco Metropolitan Transportation Commission Sub-Regional and Local Cities/Counties Sub-Regional and Local Cities/Counties
Emergency Vehicle Subsystem	CHP Vehicles Combined City/County Emergency Vehicles FSP Tow Trucks Sub-regional and Local City/County Fire Dept Emergency Vehicles Sub-regional and Local City/County Police/Sheriff Vehicles	California Highway Patrol City/County of San Francisco Metropolitan Transportation Commission Sub-Regional and Local Cities/Counties Sub-Regional and Local Cities/Counties
Information Service Provider	511 System 511 Webpage and Personal Info Access System Caltrans D-4 Transportation Management System East Bay SMART Corridor Info Service Provider Media	Metropolitan Transportation Commission Metropolitan Transportation Commission Caltrans District 4 (Traffic Operations) Alameda County Congestion Management Agency Media
Information Service Provider	Oakland Transportation Management System San Jose Transportation Management System SFgo Transportation Management System TravInfo and Regional Archive System	City of Oakland City of San Jose City/County of San Francisco Metropolitan Transportation Commission

Maintenance and Construction Management	Bay Area Incident Response System (BAIRS) Maintenance and Construction Vehicle Caltrans D-4 Maintenance Vehicles	Caltrans District 4 (Traffic Operations)  Caltrans District 4 (Traffic Operations)
Personal Information Access	511 Webpage and Personal Info Access System Kiosks (transit) User Personal Computing Devices	Metropolitan Transportation Commission Transit Agencies Traveling Public (Commuters) @ Large
Remote Traveler Support	AC Transit Next Bus Arrival System BART Message Station System Caltrain Rail Center Next Train Displays MUNI Kiosks TransLink Field Equipment (Kiosks)	AC Transit Bay Area Rapid Transit District Caltrain City/County of San Francisco Metropolitan Transportation Commission
Roadway Subsystem	Caltrans D-4 TMC Roadside Equipment (TOS) Concord - Walnut Creek - Pleasant Hill SMART Corridor Roadside East Bay SMART Corridor Roadside Equipment I-580 SMART Corridor ATMS Roadside Equipment Oakland TMC Roadside Equipment San Jose TMC Roadside Equipment SFgo Roadside Equipment Silicon Valley SMART Corridor Roadside Equipment SR 4 East SMART Corridor Roadside Equipment Sub-regional and Local City/County Roadside Equipment Suisun - Fairfield - Vacaville SMART Corridor Roadside Equipment TravInfo Roadside Equipment	Caltrans District 4 (Traffic Operations) City of Concord Alameda County Congestion Management Agency City of Pleasanton City of Oakland City of San Jose City/County of San Francisco City of San Jose City of Antioch Sub-Regional and Local Cities/Counties City of Fairfield Metropolitan Transportation Commission
Toll Administration	Bay Area Toll Authority Administration/FasTrak System Caltrans FasTrak System GGBHTD Toll Authority/FasTrak System	Metropolitan Transportation Commission Caltrans District 4 (Electronic Tolling) Golden Gate Bridge Highway and Transportation District
Toll Collection	Caltrans FasTrak Toll Equipment GGBHTD Toll Collection/FasTrak Field Equipment	Caltrans District 4 (Electronic Tolling) Golden Gate Bridge Highway and Transportation District
Traffic Management	Caltrans D-4 Transportation Management System Concord - Walnut Creek - Pleasant Hill SMART Corridor ATMS East Bay SMART Corridor ATMS I-580 SMART Corridor ATMS Oakland Transportation Management System San Jose Transportation Management System SFgo Transportation Management System	Caltrans District 4 (Traffic Operations) City of Concord Alameda County Congestion Management Agency City of Pleasanton City of Oakland City of San Jose City/County of San Francisco

	<p>Silicon Valley SMART Corridor ATMS  SR 4 East SMART Corridor ATMS  Sub-regional and Local City/County Traffic Operations Systems  Suisun - Fairfield - Vacaville SMART Corridor ATMS  TravInfo and Regional Archive System</p>	<p>City of San Jose  City of Antioch  Sub-Regional and Local Cities/Counties  City of Fairfield  Metropolitan Transportation Commission</p>
Transit Management	<p>AC Transit Operations System  BART Transit/Rail Operations System  Caltrain Rail Operations System  Commuter Rail Operations System  Golden Gate Transit Operations System  MUNI Transit Operations System  Regional Transit Information System (RTIS)  SamTrans Transit Operations System  Sub-regional and Local City/County Transit Operations Systems  TransLink System  VTA Transit Operations System</p>	<p>AC Transit  Bay Area Rapid Transit District  Caltrain  Various Rail Owners - Operators  Golden Gate Bridge Highway and Transportation District  City/County of San Francisco  Metropolitan Transportation Commission  San Mateo County Transit District  Sub-Regional and Local Cities/Counties  Metropolitan Transportation Commission  Santa Clara Valley Transportation Authority</p>
Transit Vehicle Subsystem	<p>AC Transit Vehicles  BART Vehicles  Caltrain Vehicles  Commuter Rail Operations Transit Vehicle  Golden Gate Transit Vehicles  MUNI Vehicles  SamTrans Vehicles (Buses and Paratransit)  Sub-regional and Local City/County Transit Vehicles  VTA Vehicles</p>	<p>AC Transit  Bay Area Rapid Transit District  Caltrain  Various Rail Owners - Operators  Golden Gate Bridge Highway and Transportation District  City/County of San Francisco  San Mateo County Transit District  Sub-Regional and Local Cities/Counties  Santa Clara Valley Transportation Authority</p>
Vehicle	<p>Personal Vehicles with toll tags (FasTrak)</p>	<p>Traveling Public (Commuters) @ Large</p>

## **Appendix E: Bay Area Market Package Descriptions**

### **Traffic Management: ATMS**

#### **Network Surveillance (ATMS1)**

This market package includes traffic detectors, other surveillance equipment, the supporting field equipment, and wireline communications to transmit the collected data back to the Traffic Management Subsystem. The derived data can be used locally such as when traffic detectors are connected directly to a signal control system or remotely (e.g., when a CCTV system sends data back to the Traffic Management Subsystem). The data generated by this market package enables traffic managers to monitor traffic and road conditions, identify and verify incidents, detect faults in indicator operations, and collect census data for traffic strategy development and long range planning. The collected data can also be analyzed and made available to users and the Information Service Provider Subsystem.

#### **Probe Surveillance (ATMS2)**

This market package provides an alternative approach for surveillance of the roadway network. Two general implementation paths are supported by this market package: 1) wide-area wireless communications between the vehicle and Information Service Provider is used to communicate current vehicle location and status, and 2) dedicated short range communications between the vehicle and roadside is used to provide equivalent information back to the Traffic Management Subsystem. The first approach leverages wide area communications equipment that may already be in the vehicle to support personal safety and advanced traveler information services. The second approach utilizes vehicle equipment that supports toll collection, in-vehicle signing, and other short range communications applications identified within the architecture. The market package enables traffic managers to monitor road conditions, identify incidents, analyze and reduce the collected data, and make it available to users and private information providers. It requires one of the communications options identified above, roadside beacons and wireline communications for the short range communications option, data reduction software, and utilizes wireline links between the Traffic Management Subsystem and Information Service Provider Subsystem to share the collected information. Both “Opt out” and “Opt in” strategies are available to ensure the user has the ability to turn off the probe functions to ensure individual privacy. Due to the large volume of data collected by probes, data reduction techniques are required in this market package which include the ability to identify and filter out-of-bounds or extreme data reports.

#### **Surface Street Control (ATMS3)**

This market package provides the central control and monitoring equipment, communication links, and the signal control equipment that support local surface street control and/or arterial traffic management. A range of traffic signal control systems are represented by this market package ranging from static pre-timed control systems to fully traffic responsive systems that dynamically adjust control plans and strategies based on current traffic conditions and priority requests. Additionally, general advisory and traffic control information can be provided to the driver while en-route. This market package is generally an intra-jurisdictional package that does

not rely on real-time communications between separate control systems to achieve area-wide traffic signal coordination. Systems that achieve coordination across jurisdictions by using a common time base or other strategies that do not require real time coordination would be represented by this package. This market package is consistent with typical urban traffic signal control systems.

#### **Freeway Control (ATMS4)**

This market package provides the communications and roadside equipment to support ramp control, lane controls, and interchange control for freeways. Coordination and integration of ramp meters are included as part of this market package. This package is consistent with typical urban traffic freeway control systems. This package incorporates the instrumentation included in the Network Surveillance Market Package to support freeway monitoring and adaptive strategies as an option. This market package also includes the capability to utilize surveillance information for detection of incidents. Typically, the processing would be performed at a traffic management center; however, developments might allow for point detection with roadway equipment. For example, a CCTV might include the capability to detect an incident based upon image changes. Additionally, this market package allows general advisory and traffic control information to be provided to the driver while en-route.

#### **HOV Lane Management (ATMS5)**

This market package manages HOV lanes by coordinating freeway ramp meters and connector signals with HOV lane usage signals. Preferential treatment is given to HOV lanes using special bypasses, reserved lanes, and exclusive rights-of-way that may vary by time of day. Vehicle occupancy detectors may be installed to verify HOV compliance and to notify enforcement agencies of violations.

#### **Traffic Information Dissemination (ATMS6)**

This market package allows traffic information to be disseminated to drivers and vehicles using roadway equipment such as dynamic message signs or highway advisory radio. This package provides a tool that can be used to notify drivers of incidents; careful placement of the roadway equipment provides the information at points in the network where the drivers have recourse and can tailor their routes to account for the new information. This package also covers the equipment and interfaces that provide traffic information from a traffic management center to the media (for instance via a direct tie-in between a traffic management center and radio or television station computer systems), transit management center, emergency management center, and information service provider.

#### **Regional Traffic Control (ATMS7)**

This market package advances the Surface Street Control and Freeway Control Market Packages by adding the communications links and integrated control strategies that enable integrated Interjurisdictional traffic control. This market package provides for the sharing of traffic information and control among traffic management centers to support a regional control strategy. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions. This package relies principally on roadside



instrumentation supported by the Surface Street Control and Freeway Control Market Packages and adds hardware, software, and wireline communications capabilities to implement traffic management strategies which are coordinated between allied traffic management centers. Several levels of coordination are supported from sharing of information through sharing of control between traffic management centers.

### **Incident Management System (ATMS8)**

This market package manages both predicted and unexpected incidents so that the impact to the transportation network and traveler safety is minimized. Requisite incident detection capabilities are included in the freeway control market package and through the regional coordination with other traffic management and emergency management centers, weather service entities, and event promoters supported by this market package. Information from these diverse sources are collected and correlated by this market package to detect and verify incidents and implement an appropriate response. This market package provides Traffic Management Subsystem equipment that supports traffic operations personnel in developing an appropriate response in coordination with emergency management and other incident response personnel to confirmed incidents. The response may include traffic control strategy modifications and presentation of information to affected travelers using the Traffic Information Dissemination market package. The same equipment assists the operator by monitoring incident status as the response unfolds. The coordination with emergency management might be through a CAD system or through other communication with emergency field personnel. The coordination can also extend to tow trucks and other field service personnel.

### **Traffic Forecast and Demand Management (ATMS9)**

This market package includes advanced algorithms, processing, and mass storage capabilities that support historical evaluation, real-time assessment, and forecast of the roadway network performance. This includes the prediction of travel demand patterns to support better link travel time forecasts. The source data would come from the Traffic Management Subsystem itself as well as other traffic management centers and forecasted traffic loads derived from route plans supplied by the Information Service Provider Subsystem. In addition to short term forecasts, this market package provides longer range forecasts that can be used in transportation planning. This market package provides data that supports the implementation of TDM programs, and policies managing both traffic and the environment. Information on vehicle pollution levels, parking availability, usage levels, and vehicle occupancy are collected by monitoring sensors to support these functions. Demand management requests can also be made to Toll Administration, Transit Management, and Parking Management Subsystems.

### **Electronic Toll Collection (ATMS10)**

This market package provides toll operators with the ability to collect tolls electronically and detect and process violators. Variations in the fees that are collected enable implementation of demand management strategies. Dedicated short range communication between the roadway equipment and the vehicle is required as well as wireline interfaces between the toll collection equipment and transportation authorities and the financial infrastructure that supports fee collection. Vehicle tags of toll violators are read and electronically posted to vehicle owners.

Standards, inter-agency coordination, and financial clearinghouse capabilities enable regional, and ultimately national interoperability for these services. The population of toll tags and roadside readers that these systems utilize can also be used to collect road use statistics for highway authorities. This data can be collected as a natural by-product of the toll collection process or collected by separate readers that are dedicated to probe data collection.

### **Emissions Monitoring and Management (ATMS11)**

This market package monitors individual vehicle emissions and provides general air quality monitoring using distributed sensors to collect the data. The collected information is transmitted to the emissions management subsystem for processing. Both individual detection and identification of vehicles that exceed emissions standards and general area-wide monitoring of air quality are supported by this market package. For area wide monitoring, this market package measures air quality, identifies sectors that are non-compliant with air quality standards, and collects, stores and reports supporting statistical data. For point emissions monitoring, this market package measures tail pipe emissions and identifies vehicles that exceed emissions standards. The gathered information can be used to implement environmentally sensitive TDM programs, policies, and regulations.

### **Virtual TMC and Smart Probe Data (ATMS12)**

This market package provides for special requirements of rural road systems. Instead of a central TMC, the traffic management is distributed over a very wide area (e.g., a whole state or collection of states). Each locality has the capability of accessing available information for assessment of road conditions. The package uses vehicles as smart probes that are capable of measuring road conditions and providing this information to the roadway for relay to the Traffic Management Subsystem and potentially direct relay to following vehicles (i.e., the automated road signing equipment is capable of autonomous operation). In-vehicle signing is used to inform drivers of detected road conditions.

### **Standard Railroad Grade Crossing (ATMS13)**

This market package manages highway traffic at highway-rail intersections (HRIs) where operational requirements do not dictate more advanced features (e.g., where rail operational speeds are less than 80 miles per hour). Both passive (e.g., the crossbuck sign) and active warning systems (e.g., flashing lights and gates) are supported. (Note that passive systems exercise only the single interface between the roadway subsystem and the driver in the architecture definition.) These traditional HRI warning systems may also be augmented with other standard traffic management devices. The warning systems are activated on notification by interfaced wayside equipment of an approaching train. The equipment at the HRI may also be interconnected with adjacent signalized intersections so that local control can be adapted to highway-rail intersection activities. Health monitoring of the HRI equipment and interfaces is performed; detected abnormalities are reported to both highway and railroad officials through wayside interfaces and interfaces to the traffic management subsystem. Similar interfaces and services are provided for other types of multimodal crossings (e.g., draw bridges).

**Advanced Railroad Grade Crossing (ATMS14)**

This market package manages highway traffic at highway-rail intersections (HRIs) where operational requirements demand advanced features (e.g., where rail operational speeds are greater than 80 miles per hour). This market package includes all capabilities from the Standard Railroad Grade Crossing Market Package and augments these with additional safety features to mitigate the risks associated with higher rail speeds. The active warning systems supported by this market package include positive barrier systems which preclude entrance into the intersection when the barriers are activated. Like the Standard Package, the HRI equipment is activated on notification by wayside interface equipment which detects, or communicates with the approaching train. In this market package, additional information about the arriving train is also provided by the wayside interface equipment so that the train's direction of travel, its estimated time of arrival, and the estimated duration of closure may be derived. This enhanced information may be conveyed to the driver prior to, or in context with, warning system activation. This market package also includes additional detection capabilities which enable it to detect an entrapped or otherwise immobilized vehicle within the HRI and provide an immediate notification to highway and railroad officials.

**Railroad Operations Coordination (ATMS15)**

This market package provides an additional level of strategic coordination between rail operations and traffic management centers. Rail operations provide train schedules, maintenance schedules, and any other forecast events which will result in highway-rail intersection (HRI) closures. This information is used to develop forecast HRI closure times and durations which may be used in advanced traffic control strategies or to enhance the quality of traveler information.

**Parking Facility Management (ATMS16)**

This market package provides enhanced monitoring and management of parking facilities. The included equipment assists in the management of parking operations, coordinates with transportation authorities, and supports electronic collection of parking fees. This is performed by sensing and collecting current parking facilities status, sharing the data with information service providers and traffic operations, and automatic fee collection using short range communications with the same in-vehicle equipment utilized for electronic toll collection.

**Regional Parking Management (ATMS17)**

This market package supports coordination between parking facilities to enable regional parking management strategies.

**Reversible Lane Management (ATMS18)**

This market package provides for the management of reversible lane facilities. In addition to standard surveillance capabilities, this market package includes sensory functions that detect wrong-way vehicles and other special surveillance capabilities that mitigate safety hazards associated with reversible lanes. The package includes the field equipment, physical lane access controls, and associated control electronics that manage and control these special lanes. This

market package also includes the equipment used to electronically reconfigure intersections and manage right-of-way to address dynamic demand changes and special events.

### **Speed Monitoring (ATMS19)**

This market package will monitor the speeds of vehicles traveling through a roadway system. If the speed is determined to be excessive, then roadside equipment can suggest a safe driving speed. Environmental conditions may be monitored and factored into the safe speed advisories that are provided to the motorist. This service can also support notifications to an enforcement agency to enforce the speed limit on a roadway system.

### **Drawbridge Management (ATMS20)**

This market package will support systems that manage equipment at multimodal crossings such as drawbridges at rivers and canals and other multimodal crossings. (other than railroad grade crossings which are specifically covered by other market packages). The equipment managed by this market package includes control devices (e.g., gates, warning lights, dynamic message signs) at the draw bridge as well as the information systems that keep travelers apprised of current and forecast draw bridge status.

## **Public Transportation: APTS**

### **Transit Vehicle Tracking (APTS1)**

This market package provides for an Automated Vehicle Location System to track the transit vehicle's real time schedule adherence and updates the transit system's schedule in real-time. Vehicle position may be determined either by the vehicle (e.g., through GPS) and relayed to the infrastructure or may be determined directly by the communications infrastructure. A two-way wireless communication link with the Transit Management Subsystem is used for relaying vehicle position and control measures. Fixed route transit systems may also employ beacons along the route to enable position determination and facilitate communications with each vehicle at fixed intervals. The Transit Management Subsystem processes this information, updates the transit schedule and makes real-time schedule information available to the Information Service Provider Subsystem via a wireline link.

### **Transit Fixed-Route Operations (APTS2)**

This market package performs automatic driver assignment and monitoring, as well as vehicle routing and scheduling for fixed-route services. This service uses the existing AVL database as a source for current schedule performance data, and is implemented through data processing and information display at the transit management subsystem. This data is exchanged using the existing wireline link to the information service provider where it is integrated with that from other transportation modes (e.g. rail, ferry, air) to provide the public with integrated and personalized dynamic schedules

### **Demand Response Transit Operations (APTS3)**

This market package performs automatic driver assignment and monitoring as well as vehicle routing and scheduling for demand response transit services. This package uses the existing AVL database to monitor current status of the transit fleet and supports allocation of these fleet resources to service incoming requests for transit service while also considering traffic conditions. The Transit Management Subsystem provides the necessary data processing and information display to assist the transit operator in making optimal use of the transit fleet. The Information Service Provider Subsystem may be either be operated by transit management center or be independently owned and operated by a separate service provider. In the first scenario, the traveler makes a direct request to a specific paratransit service. In the second scenario, a third party service provider determines the paratransit service is a viable means of satisfying a traveler request and uses wireline communications to make a reservation for the traveler.

### **Transit Passenger and Fare Management (APTS4)**

This market package allows for the management of passenger loading and fare payments on-board vehicles using electronic means. The payment instrument may be either a stored value or credit card. This package is implemented with sensors mounted on the vehicle to permit the driver and central operations to determine vehicle loads, and readers located either in the infrastructure or on-board the transit vehicle to allow fare payment. Data is processed, stored, and displayed on the transit vehicle and communicated as needed to the Transit Management Subsystem using existing wireless infrastructure.

### **Transit Security (APTS5)**

This market package provides for the physical security of transit passengers. An on-board security system is deployed to perform surveillance and warn of potentially hazardous situations. Public areas (e.g. stops, park and ride lots, stations) are also monitored. Information is communicated to the Transit Management Subsystem using the existing or emerging wireless (vehicle to center) or wireline (area to center) infrastructure. Security related information is also transmitted to the Emergency Management Subsystem when an emergency is identified that requires an external response. Incident information is communicated to the Information Service Provider.

### **Transit Maintenance (APTS6)**

This market package supports automatic maintenance scheduling and monitoring. On-board condition sensors monitor critical system status and transmit critical status information to the Transit Management Subsystem. Hardware and software in the Transit Management Subsystem processes this data and schedules maintenance activities.

### **Multi-modal Coordination (APTS7)**

This market package establishes two way communications between multiple transit and traffic agencies to improve service coordination. Intermodal coordination between transit agencies can increase traveler convenience at transfer points and also improve operating efficiency. Coordination between traffic and transit management is intended to improve on-time

performance of the transit system to the extent that this can be accommodated without degrading overall performance of the traffic network. More limited local coordination between the transit vehicle and the individual intersection for signal priority is also supported by this package.

### **Transit Traveler Information (APTS8)**

This market package provides transit users at transit stops and on-board transit vehicles with ready access to transit information. The information services include transit stop annunciation, imminent arrival signs, and real-time transit schedule displays that are of general interest to transit users. Systems that provide custom transit trip itineraries and other tailored transit information services are also represented by this market package.

## **Emergency Management: EM**

### **Emergency Response (EM1)**

This market package provides the computer-aided dispatch systems, emergency vehicle equipment, and wireless communications that enable safe and rapid deployment of appropriate resources to an emergency. Coordination between Emergency Management Subsystems supports emergency notification and coordinated response between agencies. Existing wide area wireless communications would be utilized between the Emergency Management Subsystem and an Emergency Vehicle to enable an incident command system to be established and supported at the emergency location. The Emergency Management Subsystem would include hardware and software for tracking the emergency vehicles. Public safety, traffic management, and many other allied agencies may each participate in the coordinated response managed by this package.

### **Emergency Routing (EM2)**

This market package supports dynamic routing of emergency vehicles and coordination with the Traffic Management Subsystem for special priority on the selected route(s). The Information Service Provider Subsystem supports routing for the emergency fleet based on real-time traffic conditions and the emergency routes assigned to other responding vehicles. In this market package, the Information Service Provider Subsystem would typically be integrated with the Emergency Management Subsystem in a public safety communications center. The Emergency Vehicle would also optionally be equipped with dedicated short range communications for local signal preemption.

### **Mayday Support (EM3)**

This package allows the user (driver or non-driver) to initiate a request for emergency assistance and enables the Emergency Management Subsystem to locate the user and determine the appropriate response. The Emergency Management Subsystem may be operated by the public sector or by a private sector provider. The request from the traveler needing assistance may be manually initiated or automated and linked to vehicle sensors. The data is sent to the Emergency Management subsystem using wide area wireless communications with voice as an option. Providing user location implies either a location technology within the user device or location determination within the communications infrastructure.

### **Roadway Service Patrols (EM4)**

This market package supports roadway service patrol vehicles monitoring roads that typically have incidents (flat tire, accidents, out of gas) to determine if there are problems in the traffic stream. If problems are detected then the roadway service patrol vehicles will provide assistance to the motorist (e.g., push a vehicle to the shoulder or median).

## **Traveler Information: ATIS**

### **Broadcast Traveler Information (ATIS1)**

This market package provides the user with a basic set of ATIS services; its objective is early acceptance. It involves the collection of traffic conditions, advisories, general public transportation, toll and parking information, incident information, air quality and weather information, and the near real time dissemination of this information over a wide area through existing infrastructures and low cost user equipment (e.g., FM subcarrier, cellular data broadcast). Different from the market package ATMS6--Traffic Information Dissemination--which provides the more basic HAR and DMS information capabilities, ATIS1 provides the more sophisticated digital broadcast service. Successful deployment of this market package relies on availability of real-time traveler information from roadway instrumentation, probe vehicles or other sources.

### **Interactive Traveler Information (ATIS2)**

This market package provides tailored information in response to a traveler request. Both real-time interactive request/response systems and information systems that "push" a tailored stream of information to the traveler based on a submitted profile are supported. The traveler can obtain current information regarding traffic conditions, transit services, ride share/ride match, parking management, and pricing information. A range of two-way wide-area wireless and wireline communications systems may be used to support the required digital communications between traveler and the information service provider. A variety of interactive devices may be used by the traveler to access information prior to a trip or en-route to include phone, kiosk, Personal Digital Assistant, personal computer, and a variety of in-vehicle devices. Successful deployment of this market package relies on availability of real-time transportation data from roadway instrumentation, probe vehicles or other means.

### **Autonomous Route Guidance (ATIS3)**

This market package relies on in-vehicle sensory, location determination, computational, map database, and interactive driver interface equipment to enable route planning and detailed route guidance based on static, stored information. No communication with the infrastructure is assumed or required. Identical capabilities are available to the traveler outside the vehicle by integrating a similar suite of equipment into portable devices.

**Dynamic Route Guidance (ATIS4)**

This market package offers the user advanced route planning and guidance which is responsive to current conditions. The package combines the autonomous route guidance user equipment with a digital receiver capable of receiving real-time traffic, transit, and road condition information which is considered by the user equipment in provision of route guidance.

**ISP-Based Route Guidance (ATIS5)**

This market package offers the user advanced route planning and guidance which is responsive to current conditions. Different than the Dynamic Route Guidance Market Package, this market package moves the route planning function from the user device to the information service provider. This approach simplifies the user equipment requirements and can provide the infrastructure better information on which to predict future traffic and appropriate control strategies to support basic route planning with minimal user equipment. The package includes both turn by turn route guidance as might be used in a vehicle, as well as pre-trip routes. The package includes two way data communications and optionally also equips the vehicle with the databases, location determination capability, and display technology to support turn by turn route guidance.

**Integrated Transportation Management/Route Guidance (ATIS6)**

This market package allows a traffic management center to continuously optimize the traffic control strategy based on near-real time information on intended routes for a proportion of the vehicles within their network while offering the user advanced route planning and guidance which is responsive to current conditions. It would utilize the individual and ISP route planning information to optimize signal timing while at the same time providing updated signal timing information to allow optimized route plans. The use of predictive link times for this market package are possible through utilizing the market package ATMS9--Traffic forecast and Demand Management--at the traffic management center.

**Yellow Pages and Reservation (ATIS7)**

This market package enhances the Interactive Traveler Information package by making infrastructure provided yellow pages and reservation services available to the user. The same basic user equipment is included. This market package provides multiple ways for accessing information either while en-route in a vehicle using wide-area wireless communications or pre-trip via wireline connections.

**Dynamic Ridesharing (ATIS8)**

This market package enhances the Interactive Traveler Information package by adding an infrastructure provided dynamic ridesharing/ride matching capability. In terms of equipment requirements, ATIS8 is similar to ATIS7.



### **In Vehicle Signing (ATIS9)**

This market package supports distribution of traffic and travel advisory information to drivers through in-vehicle devices. It includes short range communications between roadside equipment and the vehicle and wireline connections to the Traffic Management Subsystem for coordination and control. This market package also informs the driver of both highway-highway and highway-rail intersection status.

## **Archived Data Management: AD**

### **ITS Data Mart (AD1)**

This market package provides a focused archive that houses data collected and owned by a single agency, district, private sector provider, research institution, or other organization. This focused archive typically includes data covering a single transportation mode and one jurisdiction that is collected from an operational data store and archived for future use. It provides the basic data quality, data privacy, and meta data management common to all ITS archives and provides general query and report access to archive data users.

### **ITS Data Warehouse (AD2)**

This market package includes all the data collection and management capabilities provided by the ITS Data Mart, and adds the functionality and interface definitions that allow collection of data from multiple agencies and data sources spanning across modal and jurisdictional boundaries. It performs the additional transformations and provides the additional meta data management features that are necessary so that all this data can be managed in a single repository with consistent formats. The potential for large volumes of varied data suggests additional on-line analysis and data mining features that are also included in this market package in addition to the basic query and reporting user access features offered by the ITS Data Mart.

### **ITS Virtual Data Warehouse (AD3)**

This market package provides the same broad access to multimodal, multidimensional data from varied data sources as in the ITS Data Warehouse Market Package, but provides this access using enhanced interoperability between physically distributed ITS archives that are each locally managed. Requests for data that are satisfied by access to a single repository in the ITS Data Warehouse Market Package are parsed by the local archive and dynamically translated to requests to remote archives which relay the data necessary to satisfy the request.

## **Maintenance and Construction (MC)**

### **Maintenance and Construction Vehicle Tracking (MC01)**

This market package will track the location of maintenance and construction vehicles and other equipment to ascertain the progress of their activities. These activities can include ensuring the correct roads are being plowed and work activity is being performed at the correct locations.

### **Maintenance and Construction Vehicle Maintenance (MC02)**

This market package will automate vehicle maintenance scheduling and manage both routine and corrective maintenance activities on vehicles and other maintenance and construction equipment. It includes on-board sensors capable of automatically performing diagnostics for maintenance and construction vehicles for scheduling vehicle maintenance.

### **Road Weather Data Collection (MC03)**

This market package collects current road and weather conditions using data collected from environmental sensors deployed on and about the roadway (or guideway in the case of transit related rail systems). In addition to fixed sensor stations at the roadside, sensing of the roadway environment can also occur from sensor systems located on Maintenance and Construction Vehicles and on-board sensors provided by auto manufacturers. The collected environmental data is used by the Weather Information Processing and Distribution Market Package to process the information and make decisions on operations.

### **Weather Information Processing and Distribution (MC04)**

This market package processes the environmental information collected from the Environmental Collection Market Package. The Weather Information Processing and Distribution Market Package uses the environmental data to detect environmental hazards such as icy road conditions, high winds, dense fog, etc. so system operators and decision support systems can make decision on corrective actions to take. The continuing updates of road condition information and current temperatures can be used by system operators to more effectively deploy road maintenance resources, issue general traveler advisories, support location specific warnings to drivers using the Traffic Information Dissemination Market Package, and aid operators in scheduling work activity or knowing when to resume work activity.

### **Roadway Automated Treatment (MC05)**

This market package supports systems that automatically treat a roadway section based on environmental or atmospheric conditions. Treatments can be in the form of fog dispersion, anti-icing chemicals, etc. The market package includes the environmental sensors that detect adverse conditions, the automated treatment system itself, and driver information systems (e.g., dynamic message signs) that warn drivers when the treatment system is activated.

**Winter Maintenance (MC06)**

This market package supports winter road maintenance in the form of snow plow operations, roadway treatment (e.g., salt spraying and other material applications) based on information received from various weather sources. Environmental conditions are also detected from environmental sensors and maintenance and construction vehicle on-board sensors.

**Roadway Maintenance and Construction (MC07)**

This market package supports numerous services for scheduled and unscheduled maintenance and construction on a roadway system or right-of-way. Maintenance services would include landscape maintenance, hazard removal (roadway debris, dead animals), routine maintenance activities (roadway cleaning, grass cutting), and repair and maintenance of both ITS and non-ITS equipment on the roadway (e.g., signs, traffic controllers, traffic detectors, dynamic message signs, traffic signals, CCTV, etc.). Environmental conditions information is also received from various weather sources to aid in scheduling maintenance and construction activities.

**Work Zone Management (MC08)**

This market package directs activity in work zones, controlling traffic through portable dynamic message signs (DMS) and informing other groups of activity (e.g., ISP, TM, other maintenance and construction centers) for better coordination management. Work zone speeds and delays are provided to the motorist prior to the work zones.

**Work Zone Safety Monitoring (MC09)**

This market package includes systems that improve work crew safety and reduce collisions between the motoring public and maintenance and construction vehicles. This market package detects vehicle intrusions in work zones and warns crew workers and drivers of imminent encroachment or other potential safety hazards. Crew movements are also monitored so that the crew can be warned of movement beyond the designated safe zone. The market package supports both stationary and mobile work zones. The intrusion detection and alarm systems may be colocated or distributed, allowing systems that detect safety issues far upstream from a work zone (e.g., detection of overdimension vehicles before they enter the work zone).

**Maintenance and Construction Activity Coordination (MC10)**

This market package supports the dissemination of maintenance and construction activity to centers which can utilize it as part of their operations, or to the Information Service Providers who can provide the information to travelers.

## **Commercial Vehicle Operations: CVO**

### **Fleet Administration (CVO1)**

This market package keeps track of vehicle location, itineraries, and fuel usage at the Fleet and Freight Management Subsystem using a cell based or satellite data link and the pre-existing wireless infrastructure. The vehicle has a processor to interface to its sensor (e.g., fuel gauge) and to the cellular data link. The Fleet and Freight Management Subsystem can provide the vehicle with dispatch instructions, and can process and respond to requests for assistance and general information from the vehicle via the cellular data link. The market package also provides the Fleet Manager with connectivity to intermodal transportation providers using the existing wireline infrastructure.

### **Freight Administration (CVO2)**

This market package tracks cargo and the cargo condition. This information is communicated with the Fleet and Freight Management Subsystem via the existing wireless infrastructure. Interconnections are provided to intermodal shippers and intermodal freight depots for tracking the cargo from source to destination.

### **Electronic Clearance (CVO3)**

This market package provides for automated clearance at roadside check facilities. The roadside check facility communicates with the Commercial Vehicle Administration subsystem over wireline to retrieve infrastructure snapshots of critical carrier, vehicle, and driver data to be used to sort passing vehicles. This package allows a good driver/vehicle/carrier to pass roadside facilities at highway speeds using transponders and dedicated short range communications to the roadside. The roadside check facility may be equipped with AVI, weighing sensors, transponder read/write devices, computer workstation processing hardware, software, and databases.

### **CV Administrative Processes (CVO04)**

This market package provides for electronic application, processing, fee collection, issuance, and distribution of CVO credential and tax filing. Through this process, carriers, drivers, and vehicles may be enrolled in the electronic clearance program provided by a separate market package which allows commercial vehicles to be screened at mainline speeds at commercial vehicle check points. Through this enrollment process, current profile databases are maintained in the Commercial Vehicle Administration Subsystem and snapshots of this database are made available to the commercial vehicle check facilities at the roadside to support the electronic clearance process.

### **International Border Electronic Clearance (CVO05)**

This market package provides for automated clearance specific to international border crossings. This package augments the electronic clearance package by allowing interface with customs

related functions and permitting NAFTA required entry and exit from the US to Canada and Mexico.

#### **Weigh-In-Motion (CVO06)**

This market package provides for high speed weigh-in-motion with or without AVI attachment. Primarily this market package provides the roadside with additional equipment, either fixed or removable. If the equipment is fixed, then it is thought to be an addition to the electronic clearance and would work in conjunction with the AVI and AVC equipment in place.

#### **Roadside CVO Safety (CVO07)**

This market package provides for automated roadside safety monitoring and reporting. It automates commercial vehicle safety inspections at the Commercial Vehicle Check roadside element. The capabilities for performing the safety inspection are shared between this market package and the On-Board CVO Safety Market Package which enables a variety of implementation options. The basic option, directly supported by this market package, facilitates safety inspection of vehicles that have been pulled in, perhaps as a result of the automated screening process provided by the Electronic Clearance Market Package. In this scenario, only basic identification data and status information is read from the electronic tag on the commercial vehicle. The identification data from the tag enables access to additional safety data maintained in the infrastructure which is used to support the safety inspection, and may also inform the pull-in decision if system timing requirements can be met. More advanced implementations, supported by the On-Board CVO Safety market package, utilize additional vehicle safety monitoring and reporting capabilities in the commercial vehicle to augment the roadside safety check.

#### **On-board CVO Safety (CVO08)**

This market package provides for on-board commercial vehicle safety monitoring and reporting. It is an enhancement of the Roadside CVO Safety Market Package and includes roadside support for reading on-board safety data via tags. This market package uses the same communication links as the Roadside CVO Safety Market Package, and provides the commercial vehicle with a wireless link (data and possibly voice) to the Fleet and Freight Management and the Emergency Management Subsystems. Safety warnings are provided to the driver as a priority with secondary requirements to notify the Fleet and Freight Management and Commercial Vehicle Check roadside elements.

#### **CVO Fleet Maintenance (CVO09)**

This market package supports maintenance of CVO fleet vehicles through close interface with on-board monitoring equipment and AVLS capabilities within the Fleet and Freight Management Subsystem. Records of vehicle mileage, repairs, and safety violations are maintained to assure safe vehicles on the highway.

## **HAZMAT Management (CVO10)**

This market package integrates incident management capabilities with commercial vehicle tracking to assure effective treatment of HAZMAT material and incidents. HAZMAT tracking is performed by the Fleet and Freight Management Subsystem. The Emergency Management subsystem is notified by the Commercial Vehicle if an incident occurs and coordinates the response. The response is tailored based on information that is provided as part of the original incident notification or derived from supplemental information provided by the Fleet and Freight Management Subsystem. The latter information can be provided prior to the beginning of the trip or gathered following the incident depending on the selected policy and implementation.

## **Advanced Vehicle Safety System: AVSS**

### **Vehicle Safety Monitoring (AVSS1)**

This market package will diagnose critical components of the vehicle and warn the driver of potential dangers. On-board sensors will determine the vehicle's condition and performance, determine on-board safety data and display information.

### **Driver Safety Monitoring (AVSS2)**

This market package will determine the driver's condition, and warn the driver of potential dangers. On-board sensors will determine the driver's condition and performance, determine on-board safety data and display information.

### **Longitudinal Safety Warning (AVSS3)**

This market package allows for longitudinal warning. It utilizes safety sensors and collision sensors. It requires on-board sensors to monitor the areas in front of and behind the vehicle and present warnings to the driver about potential hazards.

### **Lateral Safety Warning (AVSS4)**

This market package allows for lateral warning. It utilizes safety sensors and collision sensors. It requires on-board sensors to monitor the areas to the sides of the vehicle and present warnings to the driver about potential hazards.

### **Intersection Safety Warning (AVSS5)**

This market package will determine the probability of a collision in an equipped intersection (either highway-highway or highway-rail) and provide timely warnings to drivers in response to hazardous conditions. Monitors in the roadway infrastructure assess vehicle locations and speeds near an intersection. Using this information, a warning is determined and communicated to the approaching vehicle using a short range communications system. Information can be provided to the driver through the market package ATIS9--In-Vehicle Signing.

**Pre-Crash Restraint Deployment (AVSS6)**

This market package provides in-vehicle sensors to monitor the vehicle's local environment, determine collision probability and deploy a pre-crash safety system. It will include on-board sensors to measure lateral and longitudinal gaps and together with weather and roadway conditions will determine lateral and longitudinal collision probability. It will have the mechanism to deploy a pre-crash safety system.

**Driver Visibility Improvement (AVSS7)**

This market package will enhance driver visibility using an enhanced vision system. On-board display hardware is needed

***Advanced Vehicle Longitudinal Control (AVSS8)***

This market package automates the speed and headway control functions on board the vehicle. It utilizes safety sensors and collision sensors combined with vehicle dynamics processing to control the throttle and brakes. It requires on-board sensors to measure longitudinal gaps and a processor for controlling the vehicle speed.

**Advanced Vehicle Lateral Control (AVSS9)**

This market package automates the steering control on board the vehicle. It utilizes safety sensors and collision sensors combined with vehicle dynamics processing to control the steering. It requires on-board sensors to measure lane position and lateral deviations and a processor for controlling the vehicle steering.

**Intersection Collision Avoidance (AVSS10)**

This market package will determine the probability of an intersection collision and provide timely warnings to approaching vehicles so that avoidance actions can be taken. This market package builds on the Intersection Collision Warning infrastructure and in-vehicle equipment and adds equipment in the vehicle that can take control of the vehicle in emergency situations. The same monitors in the roadway infrastructure are needed to assess vehicle locations and speeds near an intersection. This information is determined and communicated to the approaching vehicle using a short range communications system. The vehicle uses this information to develop control actions which alter the vehicle's speed and steering control and potentially activate its pre-crash safety system.

**Automated Highway System (AVSS11)**

This market package enables "hands-off" operation of the vehicle on the automated portion of the highway system. Implementation requires lateral lane holding, vehicle speed and steering control, and Automated Highway System check-in and checkout. This market package currently supports a balance in intelligence allocation between infrastructure and the vehicle pending selection of a single operational concept by the AHS consortium.

## **Appendix F: Bay Area ITS Inventory and Market Packages**



## Bay Area Market Packages and Associated Elements

<i>Market Pkg.</i>	<i>Market Pkg. Name</i>	<i>Stakeholder Name</i>	<i>Element Name</i>
ATMS01	Network Surveillance	Alameda County Congestion Management Agency	East Bay SMART Corridor Info Service Provider
		Alameda County Congestion Management Agency	East Bay SMART Corridor Roadside Equipment
		Alameda County Congestion Management Agency	East Bay SMART Corridor ATMS
		Caltrans District 4 (Traffic Operations)	Caltrans D-4 Transportation Management System
		Caltrans District 4 (Traffic Operations)	Caltrans D-4 TMC Roadside Equipment (TOS)
		City of Antioch	SR 4 East SMART Corridor Roadside Equipment
		City of Antioch	SR 4 East SMART Corridor ATMS
		City of Concord	Concord - Walnut Creek - Pleasant Hill SMART
		City of Concord	Concord - Walnut Creek - Pleasant Hill SMART
		City of Fairfield	Suisun - Fairfield - Vacaville SMART Corridor ATMS
		City of Fairfield	Suisun - Fairfield - Vacaville SMART Corridor
		City of Oakland	Oakland Transportation Management System
		City of Oakland	Oakland TMC Roadside Equipment
		City of Pleasanton	I-580 SMART Corridor ATMS
		City of Pleasanton	I-580 SMART Corridor ATMS Roadside Equipment
		City of San Jose	Silicon Valley SMART Corridor ATMS
		City of San Jose	San Jose Transportation Management System
		City of San Jose	Silicon Valley SMART Corridor Roadside Equipment
		City of San Jose	San Jose TMC Roadside Equipment
		City/County of San Francisco	SFgo Roadside Equipment
		City/County of San Francisco	SFgo Transportation Management System
		Metropolitan Transportation Commission	TravInfo and Regional Archive System
		Metropolitan Transportation Commission	TravInfo Roadside Equipment
		Sub-Regional and Local Cities/Counties	Sub-regional and Local City/County Traffic
		Sub-Regional and Local Cities/Counties	Sub-regional and Local City/County Roadside

ATMS02	Probe Surveillance	Metropolitan Transportation Commission Metropolitan Transportation Commission	TravInfo and Regional Archive System TravInfo Roadside Equipment
ATMS03	Surface Street Control	Alameda County Congestion Management Agency Alameda County Congestion Management Agency City of Antioch City of Antioch City of Concord City of Concord City of Fairfield City of Fairfield City of Oakland City of Oakland City of Pleasanton City of Pleasanton City of San Jose City of San Jose City of San Jose City of San Jose City/County of San Francisco City/County of San Francisco Sub-Regional and Local Cities/Counties Sub-Regional and Local Cities/Counties	East Bay SMART Corridor ATMS East Bay SMART Corridor Roadside Equipment SR 4 East SMART Corridor ATMS SR 4 East SMART Corridor Roadside Equipment Concord - Walnut Creek - Pleasant Hill SMART Concord - Walnut Creek - Pleasant Hill SMART Suisun - Fairfield - Vacaville SMART Corridor ATMS Suisun - Fairfield - Vacaville SMART Corridor Oakland TMC Roadside Equipment Oakland Transportation Management System I-580 SMART Corridor ATMS I-580 SMART Corridor ATMS Roadside Equipment Silicon Valley SMART Corridor Roadside Equipment Silicon Valley SMART Corridor ATMS San Jose TMC Roadside Equipment San Jose Transportation Management System SFgo Roadside Equipment SFgo Transportation Management System Sub-regional and Local City/County Traffic Sub-regional and Local City/County Roadside
ATMS04	Freeway Control	Caltrans District 4 (Traffic Operations) Caltrans District 4 (Traffic Operations)	Caltrans D-4 Transportation Management System Caltrans D-4 TMC Roadside Equipment (TOS)
ATMS05	HOV Lane Management	Caltrans District 4 (Traffic Operations) Caltrans District 4 (Traffic Operations)	Caltrans D-4 TMC Roadside Equipment (TOS) Caltrans D-4 Transportation Management System

ATMS06	Traffic Information Dissemination	Alameda County Congestion Management Agency	East Bay SMART Corridor Roadside Equipment
		Alameda County Congestion Management Agency	East Bay SMART Corridor ATMS
		Alameda County Congestion Management Agency	East Bay SMART Corridor Info Service Provider
		California Highway Patrol	CHP Computer Aided Dispatch
		Caltrans District 4 (Traffic Operations)	Caltrans D-4 TMC Roadside Equipment (TOS)
		Caltrans District 4 (Traffic Operations)	Caltrans D-4 Transportation Management System
		Caltrans District 4 (Traffic Operations)	Bay Area Incident Response System (BAIRS)
		City of Antioch	SR 4 East SMART Corridor ATMS
		City of Antioch	SR 4 East SMART Corridor Roadside Equipment
		City of Concord	Concord - Walnut Creek - Pleasant Hill SMART
		City of Concord	Concord - Walnut Creek - Pleasant Hill SMART
		City of Fairfield	Suisun - Fairfield - Vacaville SMART Corridor
		City of Fairfield	Suisun - Fairfield - Vacaville SMART Corridor ATMS
		City of Oakland	Oakland Transportation Management System
		City of Oakland	Oakland TMC Roadside Equipment
		City of Pleasanton	I-580 SMART Corridor ATMS Roadside Equipment
		City of Pleasanton	I-580 SMART Corridor ATMS
		City of San Jose	Silicon Valley SMART Corridor ATMS
		City of San Jose	San Jose TMC Roadside Equipment
		City of San Jose	Silicon Valley SMART Corridor Roadside Equipment
		City of San Jose	San Jose Transportation Management System
		City/County of San Francisco	SFgo Roadside Equipment
		City/County of San Francisco	SFgo Transportation Management System
		Media	Media
		Metropolitan Transportation Commission	TravInfo Roadside Equipment
		Metropolitan Transportation Commission	Regional Transit Information System (RTIS)
		Metropolitan Transportation Commission	TravInfo and Regional Archive System
		Sub-Regional and Local Cities/Counties	Sub-regional and Local City/County Traffic
		Sub-Regional and Local Cities/Counties	Sub-regional and Local City/County Roadside
ATMS07	Regional Traffic Control	Alameda County Congestion Management Agency	East Bay SMART Corridor ATMS

		Caltrans District 4 (Traffic Operations)	Caltrans D-4 Transportation Management System
		City of Antioch	SR 4 East SMART Corridor ATMS
		City of Concord	Concord - Walnut Creek - Pleasant Hill SMART
		City of Fairfield	Suisun - Fairfield - Vacaville SMART Corridor ATMS
		City of Oakland	Oakland Transportation Management System
		City of Pleasanton	I-580 SMART Corridor ATMS
		City of San Jose	Silicon Valley SMART Corridor ATMS
		City of San Jose	San Jose Transportation Management System
		City/County of San Francisco	SFgo Transportation Management System
		Sub-Regional and Local Cities/Counties	Sub-regional and Local City/County Traffic
ATMS08	Incident Management System	Alameda County Congestion Management Agency	East Bay SMART Corridor Roadside Equipment
		Alameda County Congestion Management Agency	East Bay SMART Corridor ATMS
		California Highway Patrol	CHP Computer Aided Dispatch
		California Highway Patrol	CHP Vehicles
		Caltrans District 4 (Traffic Operations)	Caltrans D-4 TMC Roadside Equipment (TOS)
		Caltrans District 4 (Traffic Operations)	Caltrans D-4 Transportation Management System
		Caltrans District 4 (Traffic Operations)	Bay Area Incident Response System (BAIRS)
		City of Antioch	SR 4 East SMART Corridor ATMS
		City of Antioch	SR 4 East SMART Corridor Roadside Equipment
		City of Concord	Concord - Walnut Creek - Pleasant Hill SMART
		City of Concord	Concord - Walnut Creek - Pleasant Hill SMART
		City of Fairfield	Suisun - Fairfield - Vacaville SMART Corridor ATMS
		City of Fairfield	Suisun - Fairfield - Vacaville SMART Corridor
		City of Oakland	Oakland TMC Roadside Equipment
		City of Oakland	Oakland Transportation Management System
		City of Pleasanton	I-580 SMART Corridor ATMS Roadside Equipment
		City of Pleasanton	I-580 SMART Corridor ATMS
		City of San Jose	Silicon Valley SMART Corridor Roadside Equipment
		City of San Jose	Silicon Valley SMART Corridor ATMS
		City of San Jose	San Jose TMC Roadside Equipment

		City of San Jose	San Jose Transportation Management System
		City/County of San Francisco	SFgo Roadside Equipment
		City/County of San Francisco	SFgo Transportation Management System
		Metropolitan Transportation Commission	FSP Tow Trucks
		Metropolitan Transportation Commission	Freeway Service Patrol (FSP)
ATMS09	Traffic Forecast and Demand Management	Caltrans District 4 (Traffic Operations)	Caltrans D-4 TMC Roadside Equipment (TOS)
		Caltrans District 4 (Traffic Operations)	Caltrans D-4 Transportation Management System
		Partners for Advanced Transit and Highways	Performance Monitoring System (PeMS)
ATMS10	Electronic Toll Collection	Caltrans District 4 (Electronic Tolling)	Caltrans FasTrak System
		Caltrans District 4 (Electronic Tolling)	Caltrans FasTrak Toll Equipment
		Caltrans District 4 (Traffic Operations)	Caltrans D-4 Transportation Management System
ATMS10	Electronic Toll Collection	Financial Institutions	Financial Institutions
		Golden Gate Bridge Highway and Transportation	GGBHTD Toll Authority/FasTrak System
		Golden Gate Bridge Highway and Transportation	GGBHTD Toll Collection/FasTrak Field Equipment
		Metropolitan Transportation Commission	Bay Area Toll Authority Administration/FasTrak
		Traveling Public (Commuters) @ Large	Personal Vehicles with toll tags (FasTrak)
ATMS13	Standard Railroad Grade Crossing	Alameda County Congestion Management Agency	East Bay SMART Corridor Roadside Equipment
		Caltrans District 4 (Traffic Operations)	Caltrans D-4 TMC Roadside Equipment (TOS)
		City of Antioch	SR 4 East SMART Corridor Roadside Equipment
		City of Concord	Concord - Walnut Creek - Pleasant Hill SMART
		City of Fairfield	Suisun - Fairfield - Vacaville SMART Corridor
		City of Oakland	Oakland TMC Roadside Equipment
		City of Pleasanton	I-580 SMART Corridor ATMS Roadside Equipment
		City of San Jose	San Jose TMC Roadside Equipment
		City of San Jose	Silicon Valley SMART Corridor Roadside Equipment
		City/County of San Francisco	SFgo Roadside Equipment

		Sub-Regional and Local Cities/Counties	Sub-regional and Local City/County Roadside
MC01	Maintenance and Construction Vehicle Tracking	Caltrans District 4 (Traffic Operations) Caltrans District 4 (Traffic Operations)	Caltrans D-4 Maintenance Vehicles Bay Area Incident Response System (BAIRS)
MC07	Roadway Maintenance and Construction	Caltrans District 4 (Traffic Operations) Caltrans District 4 (Traffic Operations)	Caltrans D-4 Maintenance Vehicles Caltrans D-4 Transportation Management System
APTS1	Transit Vehicle Tracking	AC Transit AC Transit Bay Area Rapid Transit District Bay Area Rapid Transit District Caltrain City/County of San Francisco Golden Gate Bridge Highway and Transportation San Mateo County Transit District San Mateo County Transit District Santa Clara Valley Transportation Authority Santa Clara Valley Transportation Authority	AC Transit Vehicles AC Transit Operations System BART Vehicles BART Transit/Rail Operations System Caltrain Vehicles MUNI Vehicles Golden Gate Transit Operations System SamTrans Vehicles (Buses and Paratransit) SamTrans Transit Operations System VTA Transit Operations System VTA Vehicles
APTS2	Transit Fixed-Route Operations	AC Transit AC Transit Bay Area Rapid Transit District Bay Area Rapid Transit District Caltrain City/County of San Francisco City/County of San Francisco Golden Gate Bridge Highway and Transportation Golden Gate Bridge Highway and Transportation San Mateo County Transit District	AC Transit Operations System AC Transit Vehicles BART Transit/Rail Operations System BART Vehicles Caltrain Vehicles MUNI Vehicles MUNI Transit Operations System Golden Gate Transit Operations System Golden Gate Transit Vehicles SamTrans Vehicles (Buses and Paratransit)

		San Mateo County Transit District	SamTrans Transit Operations System
		Santa Clara Valley Transportation Authority	VTA Vehicles
		Santa Clara Valley Transportation Authority	VTA Transit Operations System
		Sub-Regional and Local Cities/Counties	Sub-regional and Local City/County Transit Vehicles
		Sub-Regional and Local Cities/Counties	Sub-regional and Local City/County Transit
		Various Rail Owners - Operators	Commuter Rail Operations System
APTS3	Demand Response Transit Operations	AC Transit	AC Transit Operations System
		AC Transit	AC Transit Vehicles
		City/County of San Francisco	MUNI Transit Operations System
		City/County of San Francisco	MUNI Vehicles
		San Mateo County Transit District	SamTrans Transit Operations System
		San Mateo County Transit District	SamTrans Vehicles (Buses and Paratransit)
		Santa Clara Valley Transportation Authority	VTA Vehicles
		Santa Clara Valley Transportation Authority	VTA Transit Operations System
		Sub-Regional and Local Cities/Counties	Sub-regional and Local City/County Transit Vehicles
		Sub-Regional and Local Cities/Counties	Sub-regional and Local City/County Transit
APTS4	Transit Passenger and Fare Management	AC Transit	AC Transit Operations System
		AC Transit	AC Transit Vehicles
		Bay Area Rapid Transit District	BART Vehicles
		Bay Area Rapid Transit District	BART Transit/Rail Operations System
		Caltrain	Caltrain Vehicles
		Caltrain	Caltrain Rail Center Next Train Displays
		City/County of San Francisco	MUNI Transit Operations System
		City/County of San Francisco	MUNI Vehicles
		City/County of San Francisco	MUNI Kiosks
		Financial Institutions	Financial Institutions
		Golden Gate Bridge Highway and Transportation	Golden Gate Transit Vehicles
		Golden Gate Bridge Highway and Transportation	Golden Gate Transit Operations System

		Metropolitan Transportation Commission	TransLink System
		Metropolitan Transportation Commission	TransLink Field Equipment (Kiosks)
		San Mateo County Transit District	SamTrans Vehicles (Buses and Paratransit)
		San Mateo County Transit District	SamTrans Transit Operations System
		Santa Clara Valley Transportation Authority	VTA Vehicles
		Santa Clara Valley Transportation Authority	VTA Transit Operations System
		Various Rail Owners - Operators	Commuter Rail Operations System
APTS5	Transit Security	AC Transit	AC Transit Operations System
		AC Transit	AC Transit Vehicles
		Bay Area Rapid Transit District	BART Transit/Rail Operations System
		Bay Area Rapid Transit District	BART Vehicles
		Caltrain	Caltrain Vehicles
		Caltrain	Caltrain Rail Center Next Train Displays
		City/County of San Francisco	MUNI Transit Operations System
		City/County of San Francisco	MUNI Vehicles
		Golden Gate Bridge Highway and Transportation	Golden Gate Transit Vehicles
		Golden Gate Bridge Highway and Transportation	Golden Gate Transit Operations System
		San Mateo County Transit District	SamTrans Transit Operations System
		San Mateo County Transit District	SamTrans Vehicles (Buses and Paratransit)
		Santa Clara Valley Transportation Authority	VTA Transit Operations System
		Santa Clara Valley Transportation Authority	VTA Vehicles
		Sub-Regional and Local Cities/Counties	Sub-regional and Local City/County Transit Vehicles
		Sub-Regional and Local Cities/Counties	Sub-regional and Local City/County Police/Sheriff
		Sub-Regional and Local Cities/Counties	Sub-regional and Local City/County Transit
APTS6	Transit Maintenance	AC Transit	AC Transit Operations System
		Bay Area Rapid Transit District	BART Transit/Rail Operations System
		City/County of San Francisco	MUNI Transit Operations System
		Golden Gate Bridge Highway and Transportation	Golden Gate Transit Operations System



		San Mateo County Transit District	SamTrans Transit Operations System
		Santa Clara Valley Transportation Authority	VTA Transit Operations System
APTS7	Multi-modal Coordination	AC Transit	AC Transit Vehicles
		AC Transit	AC Transit Operations System
		Alameda County Congestion Management Agency	East Bay SMART Corridor ATMS
		Alameda County Congestion Management Agency	East Bay SMART Corridor Roadside Equipment
		City of San Jose	San Jose Transportation Management System
		City of San Jose	Silicon Valley SMART Corridor Roadside Equipment
		City of San Jose	Silicon Valley SMART Corridor ATMS
		City of San Jose	San Jose TMC Roadside Equipment
		San Mateo County Transit District	SamTrans Vehicles (Buses and Paratransit)
		San Mateo County Transit District	SamTrans Transit Operations System
		Santa Clara Valley Transportation Authority	VTA Vehicles
		Santa Clara Valley Transportation Authority	VTA Transit Operations System
APTS8	Transit Traveler Information	AC Transit	AC Transit Vehicles
		AC Transit	AC Transit Next Bus Arrival System
		AC Transit	AC Transit Operations System
		Bay Area Rapid Transit District	BART Vehicles
		Bay Area Rapid Transit District	BART Message Station System
		Bay Area Rapid Transit District	BART Transit/Rail Operations System
		Caltrain	Caltrain Vehicles
		Caltrain	Caltrain Rail Center Next Train Displays
		City/County of San Francisco	MUNI Transit Operations System
		City/County of San Francisco	MUNI Vehicles
		City/County of San Francisco	MUNI Kiosks
		Golden Gate Bridge Highway and Transportation	Golden Gate Transit Operations System
		Metropolitan Transportation Commission	Regional Transit Information System (RTIS)
		Metropolitan Transportation Commission	TransLink System

		Metropolitan Transportation Commission San Mateo County Transit District San Mateo County Transit District Santa Clara Valley Transportation Authority Santa Clara Valley Transportation Authority Transit Agencies Traveling Public (Commuters) @ Large Various Rail Owners - Operators	TransLink Field Equipment (Kiosks) SamTrans Vehicles (Buses and Paratransit) SamTrans Transit Operations System VTA Transit Operations System VTA Vehicles Kiosks (transit) User Personal Computing Devices Commuter Rail Operations System
ATIS1	Broadcast Traveler Information	Alameda County Congestion Management Agency California Highway Patrol Caltrans District 4 (Traffic Operations) City of Oakland City of San Jose City/County of San Francisco Metropolitan Transportation Commission Traveling Public (Commuters) @ Large Traveling Public (Commuters) @ Large	East Bay SMART Corridor Info Service Provider CHP Computer Aided Dispatch Caltrans D-4 Transportation Management System Oakland Transportation Management System San Jose Transportation Management System SFgo Transportation Management System TravInfo and Regional Archive System User Personal Computing Devices Personal Vehicles with toll tags (FasTrak)
ATIS2	Interactive Traveler Information	Bay Area Rapid Transit District Metropolitan Transportation Commission Metropolitan Transportation Commission Traveling Public (Commuters) @ Large	BART Website (Public) Regional Transit Information System (RTIS) TravInfo and Regional Archive System User Personal Computing Devices
CVO03	Electronic Clearance	California Department of Motor Vehicles (DMV) Caltrans Headquarters Private Truck Drivers	CVO Administration (Pre-Pass) CVO Weigh Stations (Pre-Pass) Commercial Vehicles
CVO04	CV Administrative Processes	California Department of Motor Vehicles (DMV)	CVO Administration (Pre-Pass)

CVO06	Weigh-In-Motion	Caltrans Headquarters Private Truck Drivers	CVO Weigh Stations (Pre-Pass) Commercial Vehicles
EM1	Emergency Response	California Highway Patrol California Highway Patrol California Highway Patrol Caltrans District 4 (Traffic Operations) Caltrans District 4 (Traffic Operations) City/County of San Francisco City/County of San Francisco Metropolitan Transportation Commission Metropolitan Transportation Commission Metropolitan Transportation Commission Sub-Regional and Local Cities/Counties Sub-Regional and Local Cities/Counties Sub-Regional and Local Cities/Counties Sub-Regional and Local Cities/Counties Sub-Regional and Local Cities/Counties	CHP Vehicles 911 Call Center (cellular) Dispatch CHP Computer Aided Dispatch Caltrans D-4 Transportation Management System Bay Area Incident Response System (BAIRS) Combined City/County Emergency Services Center Combined City/County Emergency Vehicles Bay Area Call Box Call Answering Center (CAC) FSP Tow Trucks Freeway Service Patrol (FSP) 911 Call Center (land line) Dispatch Sub-regional and Local City/County Police/Sheriff Sub-regional and Local City/County Fire Department Sub-regional and Local City/County Police/Sheriff Sub-regional and Local City/County Fire Dept
EM2	Emergency Routing	Alameda County Congestion Management Agency California Highway Patrol California Highway Patrol Caltrans District 4 (Traffic Operations) City of Antioch City of Concord City of Fairfield City of Oakland City of Oakland City of Pleasanton	East Bay SMART Corridor Roadside Equipment CHP Vehicles CHP Computer Aided Dispatch Caltrans D-4 TMC Roadside Equipment (TOS) SR 4 East SMART Corridor Roadside Equipment Concord - Walnut Creek - Pleasant Hill SMART Suisun - Fairfield - Vacaville SMART Corridor Oakland Transportation Management System Oakland TMC Roadside Equipment I-580 SMART Corridor ATMS Roadside Equipment

		City of San Jose	San Jose TMC Roadside Equipment
		City of San Jose	San Jose Transportation Management System
		City of San Jose	Silicon Valley SMART Corridor Roadside Equipment
		City/County of San Francisco	Combined City/County Emergency Vehicles
		City/County of San Francisco	SFgo Roadside Equipment
		City/County of San Francisco	SFgo Transportation Management System
		Metropolitan Transportation Commission	FSP Tow Trucks
		Metropolitan Transportation Commission	Freeway Service Patrol (FSP)
		Sub-Regional and Local Cities/Counties	Sub-regional and Local City/County Roadside
		Sub-Regional and Local Cities/Counties	Sub-regional and Local City/County Traffic
		Sub-Regional and Local Cities/Counties	Sub-regional and Local City/County Police/Sheriff
		Sub-Regional and Local Cities/Counties	Sub-regional and Local City/County Fire Department
		Sub-Regional and Local Cities/Counties	Sub-regional and Local City/County Fire Dept
		Sub-Regional and Local Cities/Counties	Sub-regional and Local City/County Police/Sheriff
EM4	Roadway Service Patrols	California Highway Patrol	CHP Computer Aided Dispatch
		California Highway Patrol	CHP Vehicles
		Metropolitan Transportation Commission	FSP Tow Trucks
		Metropolitan Transportation Commission	Freeway Service Patrol (FSP)
AD1	ITS Data Mart	AC Transit	AC Transit Operations System
		Alameda County Congestion Management Agency	East Bay SMART Corridor ATMS
		Bay Area Rapid Transit District	BART Transit/Rail Operations System
		California Highway Patrol	CHP Computer Aided Dispatch
		Caltrans District 4 (Traffic Operations)	Caltrans D-4 Transportation Management System
		City of Antioch	SR 4 East SMART Corridor ATMS
		City of Fairfield	Suisun - Fairfield - Vacaville SMART Corridor ATMS
		City of Oakland	Oakland Transportation Management System
		City of Pleasanton	I-580 SMART Corridor ATMS
		City of San Jose	Silicon Valley SMART Corridor ATMS

		City of San Jose	San Jose Transportation Management System
		City/County of San Francisco	MUNI Transit Operations System
		City/County of San Francisco	SFgo Transportation Management System
		Golden Gate Bridge Highway and Transportation	Golden Gate Transit Operations System
		Metropolitan Transportation Commission	Regional Transit Information System (RTIS)
		Metropolitan Transportation Commission	TravInfo and Regional Archive System
		Partners for Advanced Transit and Highways	Performance Monitoring System (PeMS)
AD2	ITS Data Warehouse	Metropolitan Transportation Commission	Bay Area Toll Authority Administration/FasTrak
		Metropolitan Transportation Commission	TravInfo and Regional Archive System
		Metropolitan Transportation Commission	Regional Transit Information System (RTIS)
		Partners for Advanced Transit and Highways	Performance Monitoring System (PeMS)
AD3	ITS Virtual Data Warehouse	Metropolitan Transportation Commission	TravInfo and Regional Archive System
		Partners for Advanced Transit and Highways	Performance Monitoring System (PeMS)

## **Appendix G: Interconnects and Information Flows**

**(due to the size of this appendix, it is offered as a separate document)**

**Appendix H: Detailed Listing of NTCIP Standards for the Bay Area**

**(due to the size of this appendix, it is offered as a separate document)**

## **Appendix I: National ITS Architecture Updates**

### **National ITS Architecture Version 5.0**

- **Enhancement of Security Coverage**

The most significant Version 5.0 enhancement is the improvement of the coverage of transportation security in the National ITS Architecture. These improvements include updates to the physical architecture, market packages, logical architecture, and supporting documentation. Using ITS to Enhance Transportation Security is addressed in the following areas: Transit, Rail, Freight and Commercial Vehicle, HAZMAT, Wide Area Alerts, Transportation Infrastructure, and Disaster Response and Evacuation. In addition, guidance is now offered on ways in which ITS can be made more secure. A new security document was created to define and present aspects to ITS-related surface transportation security and their applicability to the National ITS Architecture. It provides context and guidance for using the security-related parts of the National ITS Architecture when developing regional and project ITS architectures.

- **New Disaster Response and Evacuation User Service**

Disaster Response and Evacuation was added as the 33rd user service to the architecture. The new user service supports the activities and responsibilities for responding to and recovery efforts for a major disaster. It also supports evacuation and reentry activities. The inclusion of the new user service required additions to both the logical and physical architecture, the introduction of several new Market and Equipment Packages, and updating supporting architecture documentation.

- **New Security Monitoring Subsystem**

A new Security Monitoring Subsystem was added that includes surveillance and sensor equipment used to provide enhanced security and safety for transportation facilities or infrastructure.

- **Added 511 Support to the Architecture**

Version 5.0 of the National ITS Architecture includes a new Telecommunications System for Traveler Information terminator that improves support for 511 and other voice-based traveler information systems in regional and project architectures.

- **Added Market Packages and Theory of Operations Information to Hypertext**

The National ITS Architecture hypertext was updated to include additional information from the Market Package and Theory of Operations documents. All transaction sequence diagrams and associated narratives from the Theory of Operations were added to the hypertext. The hypertext was also updated to include the following from the Market Package document: market package to user service relationships, market packages that are highly applicable to the rural development tracks, ITS goals supported by market packages and related benefits metrics, early deployment market packages, and market packages that address specific transportation problems.



- **Enhanced Logical Architecture Hypertext**

The Logical Architecture Processes web pages were expanded and revised to include substantially more information for every Data Flow Diagram. Each diagram is now supported by a summary description and a set of hyperlinks to parent and child processes. The diagrams themselves are now available in portable document format (PDF) that is scalable to facilitate on-screen display and review of these diagrams.

- **Added Road Closure Management**

Version 5.0 of the National ITS Architecture includes a new "Roadway Closure Management" market package (ATMS21). Other areas of the architecture that support road closures in specific circumstances were also revised as necessary so that the roadway barrier status and control is represented consistently

- **Changed "Roadside" Class to "Field"**

The "Roadside" class, one of four entity classes defined by the National ITS Architecture, was renamed to "Field". The new name is more consistent with the scope of this class, which includes equipment that may be on the right-of-way (e.g., traffic detectors), at the roadside (e.g., commercial vehicle check stations), on other travelways (e.g., track monitoring sensors), or distributed away from any travelway (e.g., area-wide air quality sensors).

- **Transit Related Updates**

To better represent accepted transit terminology and definitions from the transit industry, the term "transit driver" was renamed to "transit vehicle operator" in all transit related areas of the Architecture. In addition, the three types of transit managers were merged into the Transit System Operators terminator. In addition, the Transit User and Traveler terminators were combined to form a single Traveler terminator.

- **Updated Standards / Architecture Relationship**

The standards mapping has been updated and revised to reflect the most current relationship between the National ITS Architecture and the emerging National ITS Standards. This update included additional standards groups in SDOMAP and the web site. These standards groups include DSRC 915 MHz, DSRC 5.9 GHz, ATIS General Use and Bandwidth-Limited, Mayday, and Incident Management. The portions of the National ITS Architecture that have not yet been addressed by standards are now highlighted in a new Future Standardization Candidates section of the hypertext.

- **Emissions Management Modifications**

The Emissions Management area of the architecture was improved. This was done to support the new Environmental Sensor Stations (ESS) standard for supporting air quality sensors. In particular, the architecture now distinguishes between air quality and vehicle emissions sensors. A new human terminator interface was created that is associated with the Emissions Management Subsystem.

- **Parking management area improvements**

The parking management aspects of the architecture were improved to better reflect the interfaces and functionality that exist today and are likely to be deployed in the future. This included the sharing of static as well as dynamic information about parking with Traffic and Transit Management functions.

## **Appendix J: Turbo Architecture™ Updates**

### **Turbo Architecture Version 3.0**

Turbo Architecture Version 3.0 supports development of regional and project architectures that take advantage of all the new features of Version 5.0 of the National ITS Architecture and include a host of new features and numerous fixes that make the software more reliable and accurate than ever.

To enhance maintenance efforts and support transition, Turbo Version 3.0 includes “Turbo Conversion”, which automatically converts existing Turbo databases of regional and project architectures so they are consistent with Version 5.0 of the National ITS Architecture. This tool provides the region with a convenient way to migrate the Bay Area Architecture to Version 5.0 so all the new architecture features can be of use. The automated portion of the conversion process itself requires only a minute or two. However, additional information needed to utilize the new reports and other documents that Version 3.0 supports may be significant.

It is important to note that in order to properly use Version 3.0 of Turbo Architecture software, the Turbo user must be familiar with the National ITS Architecture. National ITS Architecture and Turbo Architecture training courses are available for those who require additional background information on the National ITS Architecture or its application in regional and project architecture development.

Turbo Architecture allows a user to:

- Create a regional architecture (using an interview question and answer option or completely from scratch if they are really familiar with the National ITS Architecture).
- Create one or more project architectures
- Maintain consistency between the regional and project architectures
- Generate a variety of architecture reports and diagrams

The user’s architectures are saved in Microsoft Access-compatible data files. Each data file may contain one regional architecture and multiple project architectures. Turbo Architecture Version 3.0 helps the user integrate multiple project architectures with each other and with a regional architecture.

Information can be entered into Turbo Architecture using either an interview or tabular forms. The interview guides the user through a series of questions and options that result in the creation of an inventory and a set of services. The user may also go directly to the tabular forms to create this inventory and set of services. In either case, this information is the basis for the user’s architecture.

Once this initial data input is complete, Turbo Architecture provides powerful customization tools that allow the user to customize the architecture to match their specific requirements. Many reports and diagrams are available for display, print, or publication in other documents. The user can extend the National ITS Architecture by adding their own information flows and transportation elements for those areas not covered by the National ITS Architecture.